several hundred million dollars to almost three billion dollars depending upon these variables and how many facilities actually changed frequencies and whether the change was immediate or at the end of the equipment life cycle.

On a case-by-case basis, COMSAT foresees the possibility that new service operators and existing operators would negotiate financial arrangements regarding particular stations to be relocated to higher bands. However, this would be done to alleviate identified interference problems with proposed new operations. Such ad hoc arrangements would be quite different from any broad scale program created under Commission auspices to fund relocation by assessing the new operators in order to financially compensate the incumbents. Administration of such a broad scale program could get quite complicated. Questions such as who pays, the level of payment, and who gets compensated do not nearly begin to cover the plethora of issues that would likely arise.

COMSAT does not interpret the NPRM as proposing any kind of broad scale program for compensation. Nevertheless, the NPRM is unclear as to what types of arrangements are anticipated and how they might occur. In our view, the Commission should stipulate that any financial arrangements would be purely ad hoc and voluntary between the parties concerned. Reaching financial agreements should not be prerequisites for incumbents to relocate or for new operators to use the designated bands. Timing of operations and considerations of potential interference problems between new and existing operations should determine any financial arrangements that may be appropriate to alleviate particular problems.

VI. CONCLUSIONS

COMSAT supports the Commission's initiative to create emerging technologies bands in the 1850-2200 MHz segment of the spectrum. There is ample evidence in the NPRM, the OET Report, WARC-92 Gen. Docket No. 89-554, and the instant comments to support the conclusion that this band is the most appropriate part of the spectrum for emerging mobile and mobile-satellite services.

The world telecommunications community agreed at the WARC-92 Conference, with strong U.S. support, to allocate a portion of this band to MSS on a global and regional basis. The United States indicated in the Final Acts of WARC-92 that MSS services using these bands could be implemented as early as the year 1996. COMSAT believes that the Commission should proceed immediately to implement its proposals in the NPRM to transition to new services in the 1850-2200 MHz band. As an initial step, the Commission should allocate the bands 1970-2010 MHz (E-to-S) and 2160-2200 MHz (S-to-E) to the MSS as agreed at WARC-92.

The NPRM deals with a total of 350 MHz of spectrum in the 1850-2200 MHz band. WARC-92 allocated 80 MHz of this band, or about 23%, to MSS (60 MHz on a global basis and 20 MHz in Region 2 only). COMSAT has shown herein that MSS can share effectively with the Broadcast Auxiliary service, used primarily for ENG, if certain guidelines are followed to minimize interference. We noted that only one of the seven channels available for ENG in this band overlaps the WARC-92 MSS allocations and that the Commission should consider not assigning that channel to ENG in the future. For the MDS, where only 2 MHz of the 12 MHz allocation overlaps the MSS allocation in Region 2, we demonstrated that sharing is feasible under practical scenarios.

While COMSAT strongly agrees with the Commission's proposal to relocate the private fixed microwave and common carrier fixed microwave services to other bands, we showed that it is feasible for MSS and fixed services to both operate within portions of the 2 GHz band during a transitional period, e.g., 10 years, before the fixed facilities have been fully relocated to other bands. Fixed services occupy 218 MHz of the 350 MHz in the 1850-2200 MHz band. MSS proposed allocations would overlap only 27% of the fixed service allocations; MSS would not impact 73% of the existing fixed allocations. Practical sharing scenarios during the transition period are possible within the 27% of the allocation that MSS and fixed services would overlap.

Based on our assessment, we believe that MSS could be implemented in these 2 GHz bands in the 1996-1998 time frame with little adverse impact on other services. Given the lead time to design, construct, and launch satellites with new technology in these bands, the Commission should proceed to allocate these bands in 1992 as the first phase of action in this proceeding.

Relocation of the fixed services to other frequency bands should proceed in an orderly fashion and be fully completed within 10 years. The Commission should explore the feasibility of using a portion of the 1710-1850 MHz band, which is currently allocated to government services as a future home for private and common carrier fixed services, but any such consideration should in no way delay action in this proceeding. Other, higher frequency bands at 4 and 6 GHz should be able to accommodate the necessary relocation. In this regard, any financial arrangements between new occupants and incumbents in the 1850-2200 MHz band should be purely ad hoc and voluntary between the parties concerned to alleviate particular interference situations.

At this stage of development of terrestrial PCS, or FPLMTS, COMSAT believes that the space and terrestrial components should have separate allocations. The limits on the degree of spectrum sharing between space and terrestrial applications could produce an undue economic impact on the terrestrial development. There are no reasons why the allocations should not be separate.

The Commission's proposed actions in this docket are clearly on target, and we believe the public interests will be served by the specific proposals COMSAT sets forth in the instant filing.

Respectfully submitted,
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APPENDIX A

SHARING SCENARIOS WITH FIXED AND MOBILE OPERATIONS IN THE 2 GHz BANDS

A. Existing Broadcast Auxiliary and MDS Stations

In the NPRM and OET Report[1], the Commission studied three categories of uses in the 1850-2200 MHz bands: 1) general fixed services operations; 2) broadcast auxiliary fixed and mobile use; and 3) Multipoint Distribution Service (MDS). The study found that the 2 GHz fixed common carrier and private microwave services were the primary candidates for relocation to other bands. The OET Report also found that relocation of broadcast auxiliary and MDS operations should not be pursued at this time. Thus, COMSAT has examined the feasibility of MSS sharing with TV Broadcast Auxiliary Stations, i.e., Electronic News Gathering (ENG) studio transmitter links, and Multipoint Distribution Services (MDS). Specifically, we analyzed the interference potential resulting from the overlap between one full and one partial Broadcast Auxiliary service ENG channel and the MSS uplink band, and between part of one MDS channel and the Region 2 MSS downlink band. The frequency overlaps are shown in Figure 1, Section I of the main body of these comments.

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[1] "Creating New Technology Bands for Emerging Telecommunications Technology," Report OET/T 91-1, Dec. 1991 (OET Report).

1. Sharing with ENG Microwave Links

Under Part 74, of the Commission's Rules, 47 C.F.R. Part 74, TV Broadcast Auxiliary Stations are assigned two channels which would wholly or partially overlap new WARC-92 MSS uplinks: 1990-2008 MHz and 2008-2025 MHz. As shown in the Figure 1 pictorial, COMSAT has analyzed two interferences paths: (1) MSS mobile terminal uplink interference into ENG studio receiving stations; and (2) ENG mobile-van transmitter interference into MSS/GSO satellite receiver in GSO for these bands. From our data,[2] it appears that sharing between ENG mobile-to-studio links is feasible provided there is modest geographic separation between land MES transmitters and the ENG receive sites. Furthermore, the MSS carriers should avoid the most sensitive regions of the FM/TV spectra, i.e., the RF spectrum from 0.5 to 4.5 MHz from the center of the video carrier. Maritime or shipborne MES terminals would generally be located at a sufficient distance to avoid causing interference with ENG.

1.1 MSS Mobile Terminal Interference into ENG Receive Stations

ENG systems operating at 2 GHz use 12 W transmitters and an FM modulator to relay a TV transmission from a news site to

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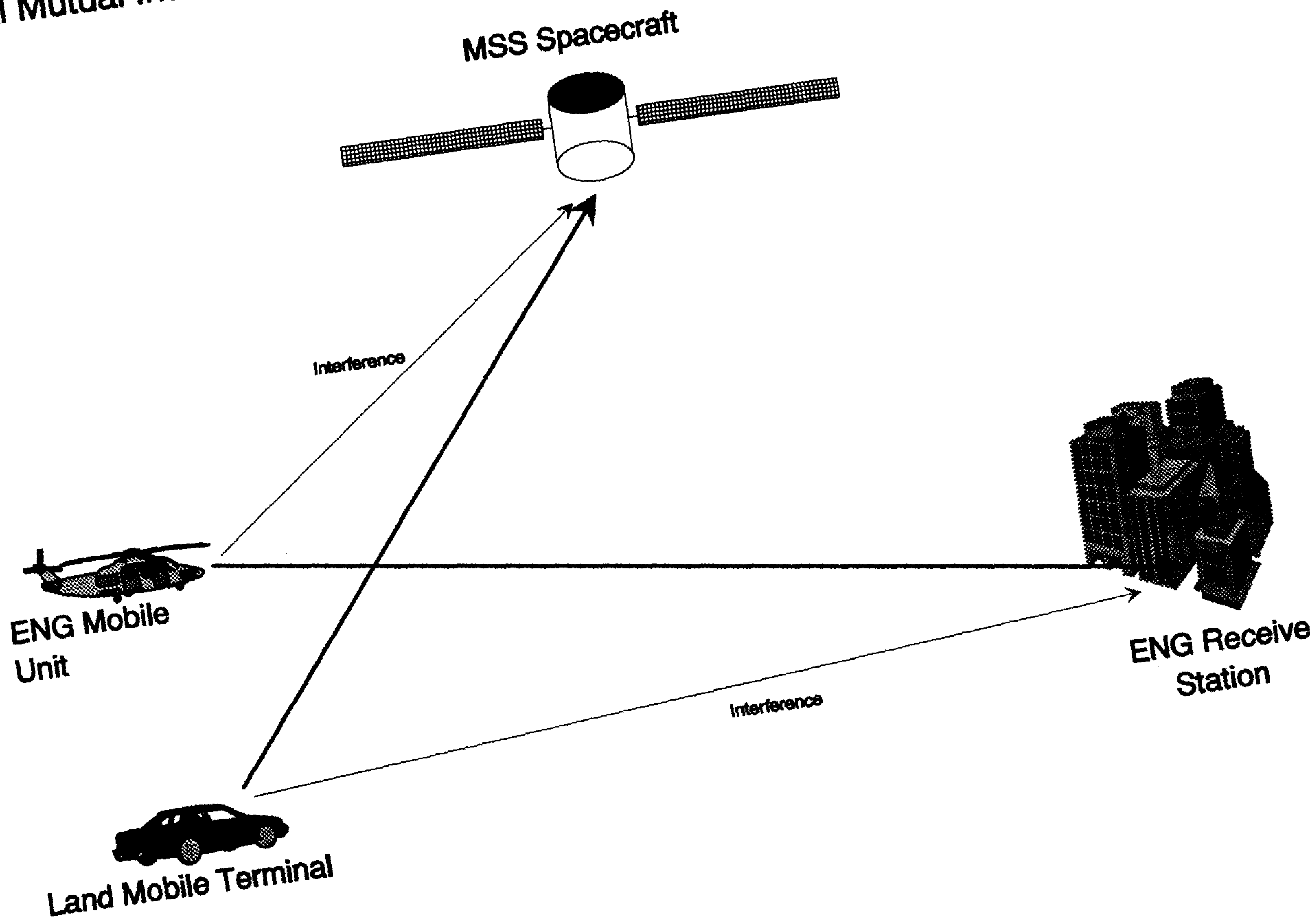
[2] The interference scenario presented here is based on the best available data COMSAT was able to obtain from the manufacturers and system integrator of ENG equipment--that typically used by the commercial TV Broadcast networks: National Systems Inc. and NuRad (antennas in ENG mobile vans and studio receiver sites).

Figure 1

Potential Mutual Interference Paths Between Mobile Satellite & ENG Microwave Links



either a TV transmitter or a domestic satellite uplink earth station. Figure 1A and 1B show the range of carrier-to interference (C/I) levels one might expect if a land mobile terminal with the same characteristics as present day Standard M terminals designed to operate in L-band, in the vicinity of an ENG TV carrier on a frequency within the 1990-2008 MHz band assigned to Broadcast Auxiliary. The reference ENG link typically achieves a 28 dB carrier-to-noise ratio within the 17-18 MHz assigned channel bandwidth.[3] From Figures 1A an d 1B, it is seen that the C/Is are negative for interference received from MSS terminals at off-axis angles of 0 and 5 degrees except for ranges greater than about 20 km. However, when interference is received at angles of 10-15 degrees off the ENG main axis antenna, the C/I becomes positive at ranges as low as 5-10 km. Standard M MESs operating at or beyond 15 km separation from ENG

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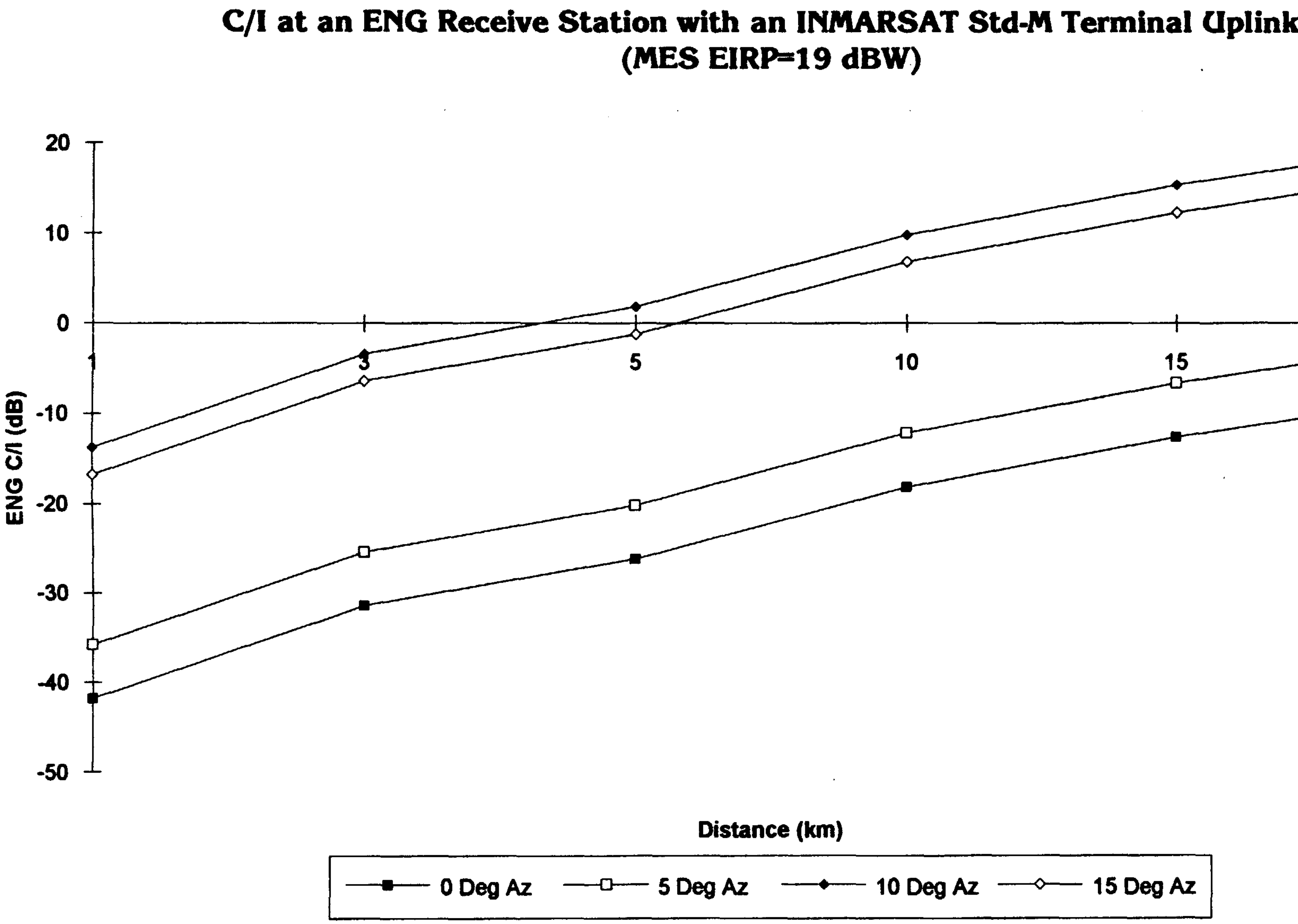
[3] The reference ENG link was assumed to be an "average path Length" with a path length of 50 km (30 miles/Table 1, page 8, OET Report). To our understanding, these links can and do operate over much shorter ranges, e.g, less than 10 miles. In this case the desired carrier would be received at higher levels. Furthermore, the full MES EIRP of 19 dBW was assumed to directed at the ENG receiver, with no allowance for any transmit antenna discrimination in the horizontal plane (MES antenna would be aimed upward, at the elevation angle of the satellite; however, the Standard M antenna radiation pattern is a fairly broad fan beam in the elevation plane, so one can not expect a high level of discrimination). The C/I was computed as a function of range and off-axis angle for a typical ENG receive antenna (NuRad SuperQuad). ENG antenna patterns are attached to this Appendix.

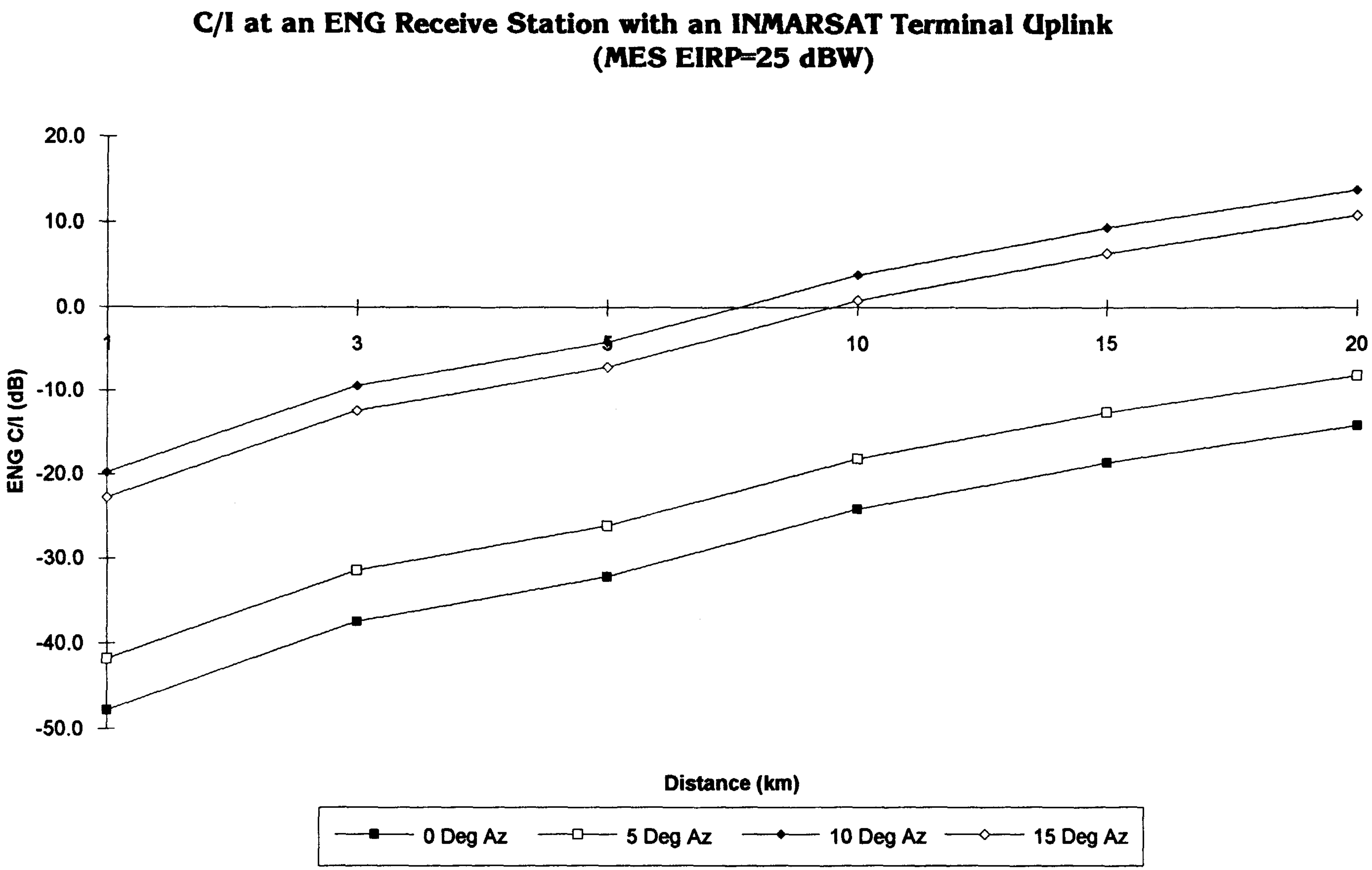
Figure 1A



C/I=(ENG Tx Pw+ENG Tx Ant G-Terr Loss+ENG Rx Ant G)-(MES EIRP-Terr Loss+ENG Rx Ant G(Az))

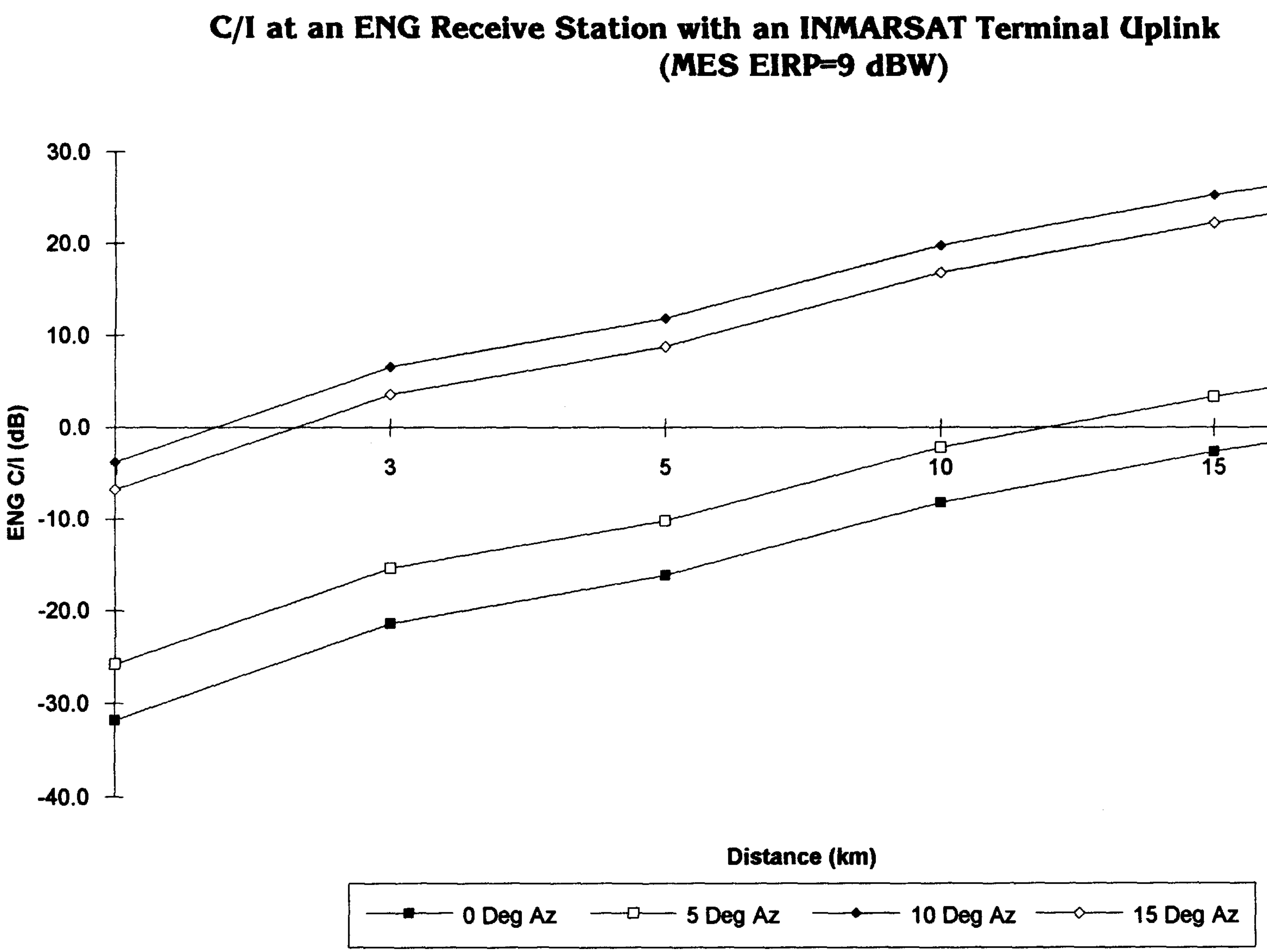
MOBMENG2.XLC

Figure 1B



C/I=(ENG Tx Pwr+ENG Tx Ant G-Terr Loss+ENG Rx Ant G)-(MES EIRP-Terr Loss+ENG Rx Ant G(Az)) MOBMENG1.XLC

Figure 1C



C/I=(ENG Tx Pwr+ENG Tx Ant G-Terr Loss+ENG Rx Ant G)-(MES EIRP-Terr Loss+ENG Rx Ant G(Az))

MOBMENG3.XLC

receivers would result in C/Is from 10 to 20 dB.[4] Newer versions of Standard M or its successor, will access INMARSAT-3 with lower EIRPs. Figure 1C shows that this will reduce the separation required for a given C/I. At first glance, these C/Is may appear to be some what marginal. However, data from a controlled experiment at COMSAT LABS was used to determine what effect narrowband MSS carriers would have on ENG FM/TV quality as a function of: (1) frequency offset from video carrier; and (2) C/I at the ENG receiver.

Thus, the plots of Figures 1A/1B/1C do <u>not</u> take into account the fact that a Standard M carrier is a narrow-band QPSK carrier (10 KHz), whose location within the 18 MHz RF spectrum of the FM/TV carrier will materially influence the amount of degradation to the ENG television signal quality (signal-to-noise) actually observed. In an effort to quantify this, COMSAT Labs made a series of measurements of the C/I required for a 1 dB degradation in Video Signal-to-Noise (S/N), with a narrow-band interference

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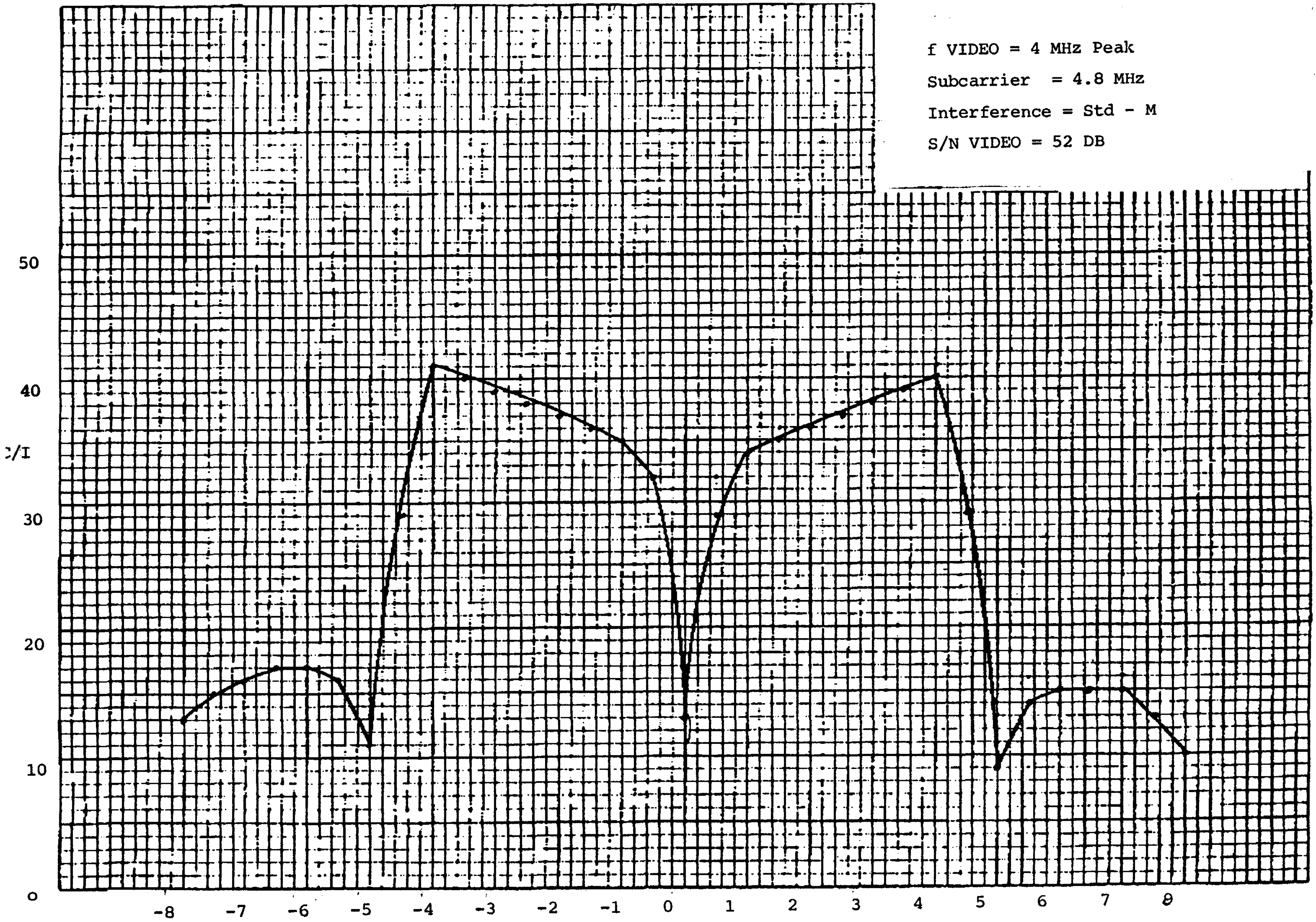
4 The Standard M EIRP for Figure 1A was assumed to be 19 dBW, which would be the standard for INMARSAT-3 spot or global beams. EIRPs as high as 25 dBW are occasionally used with Standard Ms in certain situations; i.e., beam-edge operation with a low-gain step setting within a satellite channel (See Figure 1B). The C/Is are, correspondingly, 6 dB worse than those depicted in Figure 1A for the same parameters of distance and off-axis azimuth. We also note that future INMARSAT satellites are likely to have 10 dB higher uplink antenna gain in order to operate with very low power, low-gain mobile terminals. In that case, the EIRPs will be reduced to 9 dBW, 10 dB lower as compared to the current Standard M EIRP. See Figure 1C.

FIGURE 1D

C/I REQUIRED FOR 1 DB DEGRADATION OF VIDEO S/N vs
INTERFERING CARRIER FREQUENCY OFFSET FROM CENTER OF VIDEO CARRIER



source (Standard M or B type carrier). This would be an interference criterion for barely perceptible interference. This test was performed as function of the frequency offset of the interfering MSS carrier and the center of the video carrier. (See Figure 1D) Figure 1D shows that the C/I required (within the objective of 1 dB degradation in video S/N) varies over a wide range between 10 and 40 dB, depending on the amount of frequency offset. However, C/I's as low as 10-15 dB would still meet this stringent objective if the interference source is from 5 to 8 MHz away from the center of the video carrier (or exactly on the center). In the frequency domain from 0.5 to 4.5 MHz from the center of the video carrier, a substantially higher C/I requirement, is required, in the range of 25 to 40 dB, is shown in Figure 1D. These findings may be used to facilitate frequency sharing.

For example, in the TV Broadcast Auxiliary channel, Band A, at 2008-2025 MHz, MSS (Standard M or other) emissions would impact only the lower 2 MHz edge of the 18 MHz allocation for an ENG FM/TV carrier, assuming the video carrier is centered. In this region of the TV spectra, as seen from Figure 1D, the ENG TV transmission requires C/Is of from 9 to 17 dB, for only a 1 dB loss of quality. In this case, a Standard M MES could approach the ENG at receiver with small separations of 15-20 km (5-10 KM for lower power MES), assuming its transmitter lies 10 to 15 degrees off-axis from the ENG receive antenna main beam and still not exceed a quality objective as stringent as: no more than a 1 dB degredation of video S/N.

1.2 <u>ENG Mobile Van Transmitter Interference Into Satellite Receivers</u>

The other aspect of the sharing scenario is ENG mobile van transmitters illuminating a MSS/GSO satellite with its sidelobes. In this sharing, interference from ENG FM/TV transmitters in the satellite uplink band can be technically managed, but certain measures are needed to protect satellite receivers from being over looked by ENG TV carriers. First, COMSAT examined how much signal energy the ENG antenna, driven by a 12 watt transmitter, produces at the geostationary orbit. This signal level is compared, to the level at the orbit produced by a Standard M carrier normally specified uplink EIRP. The resulting carrier-to-interference (C/Is) are presented in Figure 2A, for two different values of Standard M MES EIRP/carrier: 19 dBW and 25 dBW (the upper C/I plot is associated with the higher Standard M EIRP level). The results show a negative C/I if the elevation angle to the satellite is quite low, below about 10-15 degrees. At higher elevation angles the C/I is positive, but only in the 8-15 dB range. C/Is lower than about 15 dB will degrade these satellite links and are considered unacceptable.[5]

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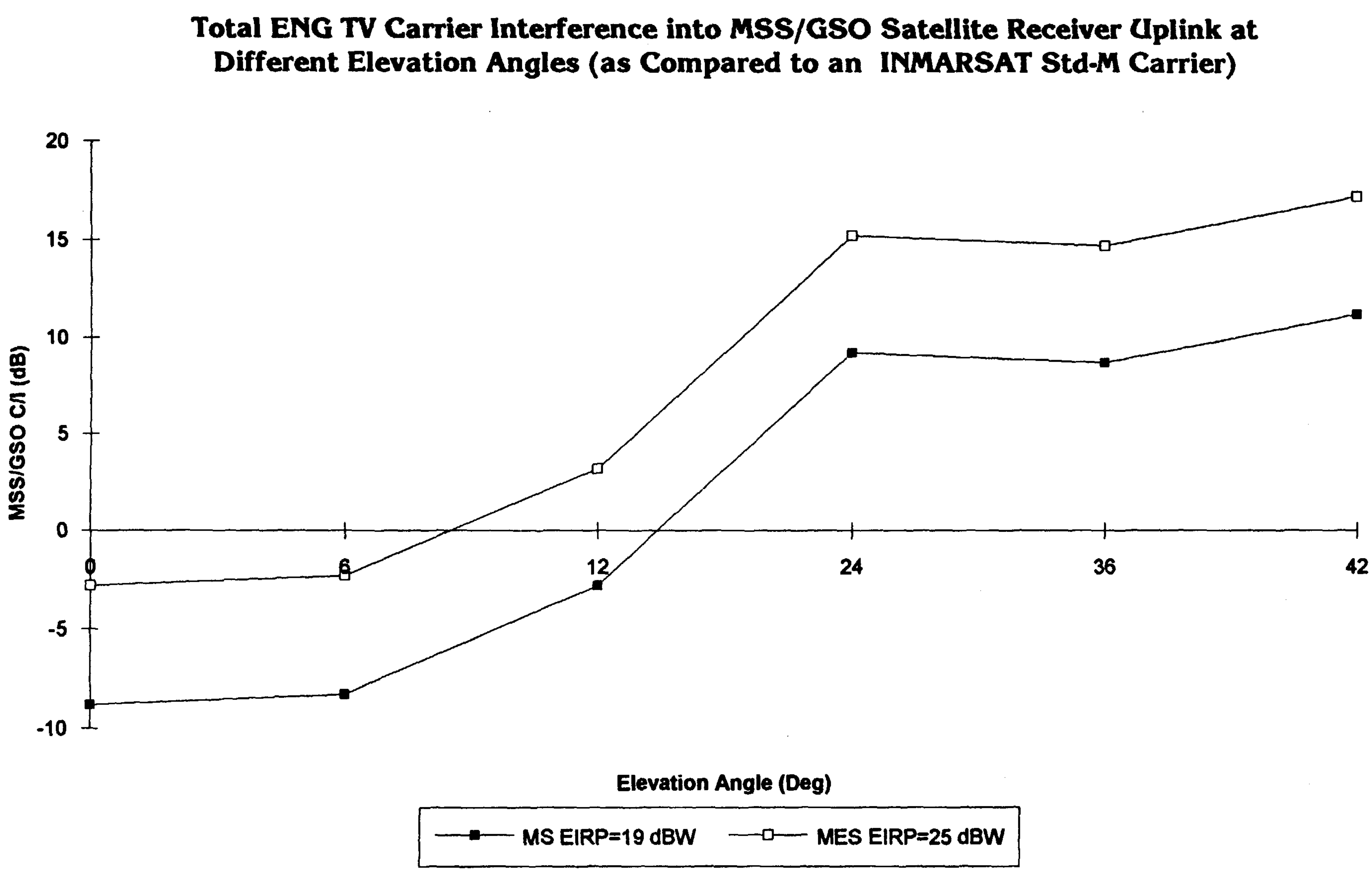
[5] Figure 2A, however, does not take into account the fact that the Standard M carrier occupies only 10 Khz, and the power of the ENG FM/TV is distributed in a roughly Gaussian shaped envelope covering the Carson's Rule bandwidth of approximately 18 MHz (twice the sum of modulating baseband plus peak frequency deviation). As a rule of thumb, an <u>individual</u> Standard M carrier will intercept only 10*LOG (bandwidth TV/bandwidth Standard M). This lowers the actual amount of interference by

Figure 2A

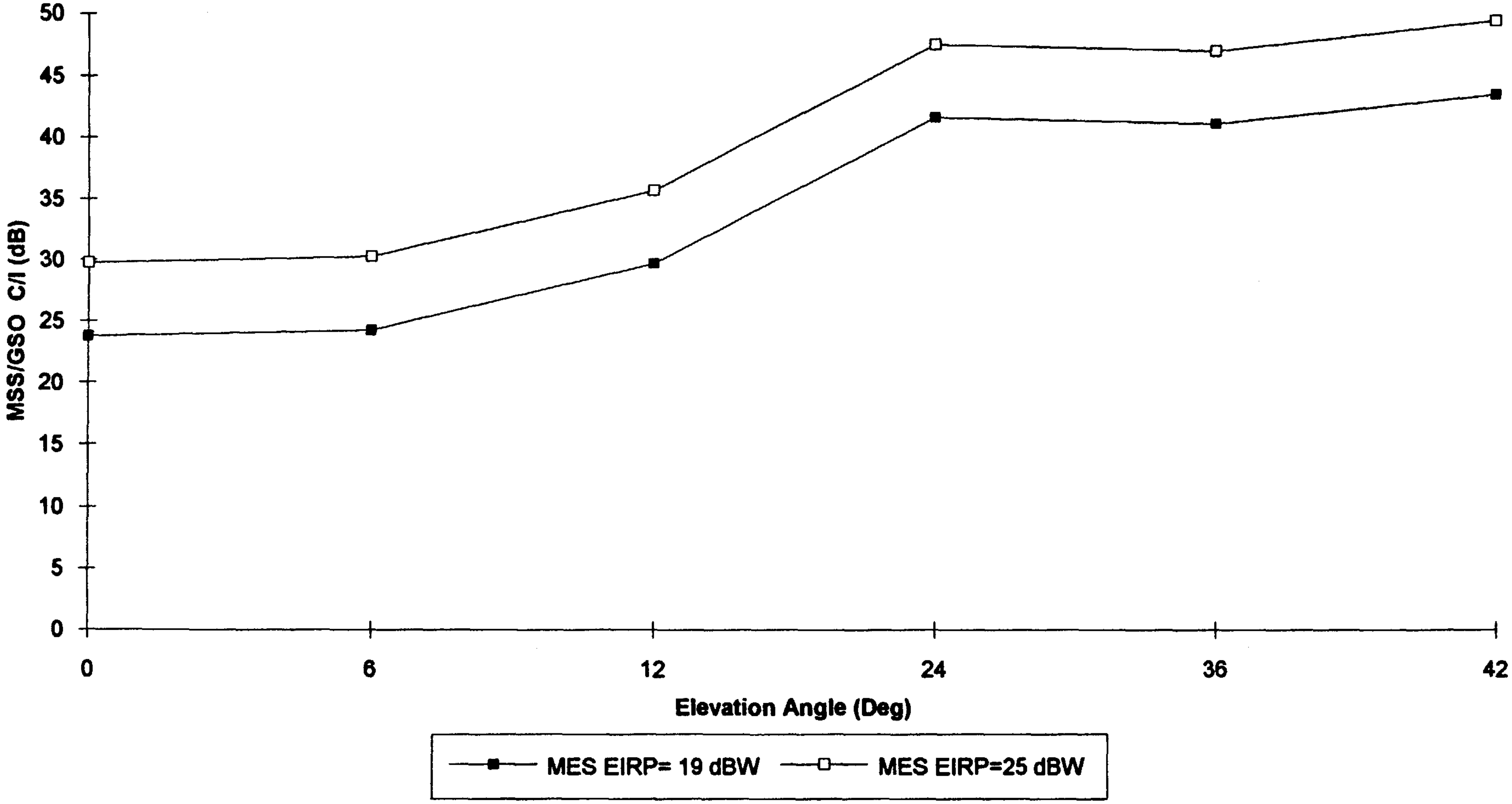


C/I=(MES EIRP-PL+Sat MSS Ant G)-(ENG Tx Pw+ENG Tx Ant G(El)-PL+Sat MSS Ant G-Xpol)

ENG2MSS0.XLC

Figure 2B (Takes into account 10log(18MHz/10MHz); Std-M/FM TV

Fractional ENG TV Carrier Interference into an Individual MSS/GSO Satellite Uplink Carrier at Different Elevation Angles



C/I=(MES EIRP-PL+Sat MSS Ant G)-(ENG Tx Pw+ENG Tx Ant G(El)-PL+Sat MSS Ant G-Xpol-10log(18M/10K))

ENG2MSS.XLC

1.3 Discussion

If INMARSAT were to operate a MSS/GSO satellite, especially a network including extensive land mobile coverage, of the continental USA (CONUS) it would undoubtedly locate the satellite at a longitude favorable for high elevation angeles in CONUS, e.g., a location over central USA of 90° W. This orbit position would result in high elevation angles and the higher range to all mobile terminals of C/Is depicted in Figures 2A/2B. Narrowband Standard M carriers will not receive excessive interference at C/Is as low as 15 dB as long as an energy dispersal waveform of 2 MHz (peak-to-peak) at the frame rate (30 Hz) is used to "spread" the energy of the carrier. This has been validated in previous laboratory tests of the effect of FM/TV carrier on SCPC voice B.E.R. performance.Note that these calculations assume co-channel interference to an individual Standard M carrier. There can still be an aggregate degradation effect to the MSS satellite caused by interference loading of the return link (feeder links)

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over 30 dB. Taking this bandwidth correction into account, the resultant C/Is have been re-plotted in Figure 2B. Accordingly, it is seen that the C/Is now exceed 25 dB, even for the lowest range of elevation angles. These interference levels are quite acceptable to satellite uplinks. However, a note of caution is that there may be a condition when the TV carrier is unmodulated. In this instance the entire power of the ENG video carrier would be concentrated in an extremely narrow band. This would produce unacceptable levels of interference to the MSS satellite--C/Is as depicted in Figure 2A would result, unless an energy dispersal waveform is modulating the video transmitter when a "no signal" condition input from the TV camera/source is experienced.

to the coast earth stations, which is in the "L-to-C" transmission direction. Table 1 illustrates this type of aggregate interference effect. The column entries show the percentage of C-Band EIRP an ENG interfering carrier would capture and the total number of TV carriers that would 100% saturate an INMARSAT-3 L-to-C transponder. At low transponder gain settings, it would take thousands of TV carriers to saturate the MSS transponder. But at the highest gain setting (175 dB is the maximum for INMARSAT-3 spot beam), just 15 TV carriers can 100% saturate the transponder (each TV carrier captures 7% of the maximum C-Band EIRP available). With Project 21, perhaps a 10 dB higher transponder would be available. This case could present a potentially difficult sharing situation as just one TV carrier with its peak gain could consume 60 to 70% of the power of the return link channel.

In sum, COMSAT recommends that the Commission consider the following suggestions for facilitating sharing between ENG and MSS. First, ENG should not transmit an unmodulated TV (without an energy dispersal waveform) in order to protect satellite uplinks. Second, it would be particularly helpful if ENG links could avoid illuminating the geostationary orbit with their main beam or near-in sidelobes. Third, if it were possible to know in advance the location of ENG TV carrier within the 18 MHz channel the MSS satellite could be equipped with a notch filter to attenuate the enery higher portions of the video carrier. (Perhaps ENG could standardize this one channel.)

Table 1

Return Link EIRP Captured by ENG FM/TV Carriers Interfering with MSS Uplink Beams: INM-3 & Project 21 Type Satellites at 2 GHz

ENG Tx Pw (dBW)	Off-Axis Angle (Deg)	ENG Gain (dBi)	ENG EIRP (dBW)	Signal Level @ GSO (dBW)	Throughput Gain (dB)	Return Link EIRP Captured (dBW)	MAX EIRP C-Band (dBW)	% Captured	No. TV Carriers To Saturate Transponder		
10.8	0.0	20.0	30.8	-159.7	155.0	-4.7	27.0	0.1%	1,472	Low Transponder Gain Setting	Inmarsat-3 Type Satellite
10.8	6.0	19.5	30.3	-160.2	155.0	-5.2	27.0	0.1%	1,651		
10.8	12.0	14.0	24.8	-165.7	155.0	-10.7	27.0	0.0%	5,859		
10.8	24.0	2.0	12.8	-177.7	155.0	-22.7	27.0	0.0%	92,858		
10.8	42.0	0.0	10.8	-179.7	155.0	-24.7	27.0	0.0%	147,170		
10.8	0.0	20.0	30.8	-159.7	160.0	0.3	27.0	0.2%	465	Medium Transponder Gain Setting	
10.8	6.0	19.5	30.3	-160.2	160.0	-0.2	27.0	0.2%	522		
10.8	12.0	14.0	24.8	-165.7	160.0	-5.7	27.0	0.1%	1,853		
10.8	24.0	2.0	12.8	-177.7	160.0	-17.7	27.0	0.0%	29,364		
10.8	42.0	0.0	10.8	-179.7	160.0	-19.7	27.0	0.0%	46,539		
10.8	0.0	20.0	30.8	-159.7	165.0	5.3	27.0	0.7%	147		
10.8	6.0	19.5	30.3	-160.2	165.0	4.8	27.0	0.6%	165		
10.8	12.0	14.0	24.8	-165.7	165.0	-0.7	27.0	0.2%	586		
10.8	24.0	2.0	12.8	-177.7	165.0	-12.7	27.0	0.0%	9,286		
10.8	42.0	0.0	10.8	-179.7	165.0	-14.7	27.0	0.0%	14,717		
10.8	0.0	20.0	30.8	-159.7	170.0	10.3	27.0	2.1%	47		
10.8	6.0	19.5	30.3	-160.2	170.0	9.8	27.0	1.9%	52		
10.8	12.0	14.0	24.8	-165.7	170.0	4.3	27.0	0.5%	185		
10.8	24.0	2.0	12.8	-177.7	170.0	-7.7	27.0	0.0%	2,936		
10.8	42.0	0.0	10.8	-179.7	170.0	-9.7	27.0	0.0%	4,654		
10.8	0.0	20.0	30.8	-159.7	175.0	15.3	27.0	6.8%	15	High Transponder Gain Setting	
10.8	6.0	19.5	30.3	-160.2	175.0	14.8	27.0	6.1%	17		
10.8	12.0	14.0	24.8	-165.7	175.0	9.3	27.0	1.7%	59		
10.8	24.0	2.0	12.8	-177.7	175.0	-2.7	27.0	0.1%	929		
10.8	42.0	0.0	10.8	-179.7	175.0	-4.7	27.0	0.1%	1,472		
10.8	0.0	20.0	30.8	-159.7	185.0	25.3	27.0	67.9%	1	Super High Transponder Gain Setting	Project 21 Type Satellite
10.8	6.0	19.5	30.3	-160.2	185.0	24.8	27.0	60.6%	2		
10.8	12.0	14.0	24.8	-165.7	185.0	19.3	27.0	17.1%	6		
10.8	24.0	2.0	12.8	-177.7	185.0	7.3	27.0	1.1%	93		
10.8	42.0	0.0	10.8	-179.7	185.0	5.3	27.0	0.7%	147		

POWCAPT.XLS

2. MSS Sharing With MDS

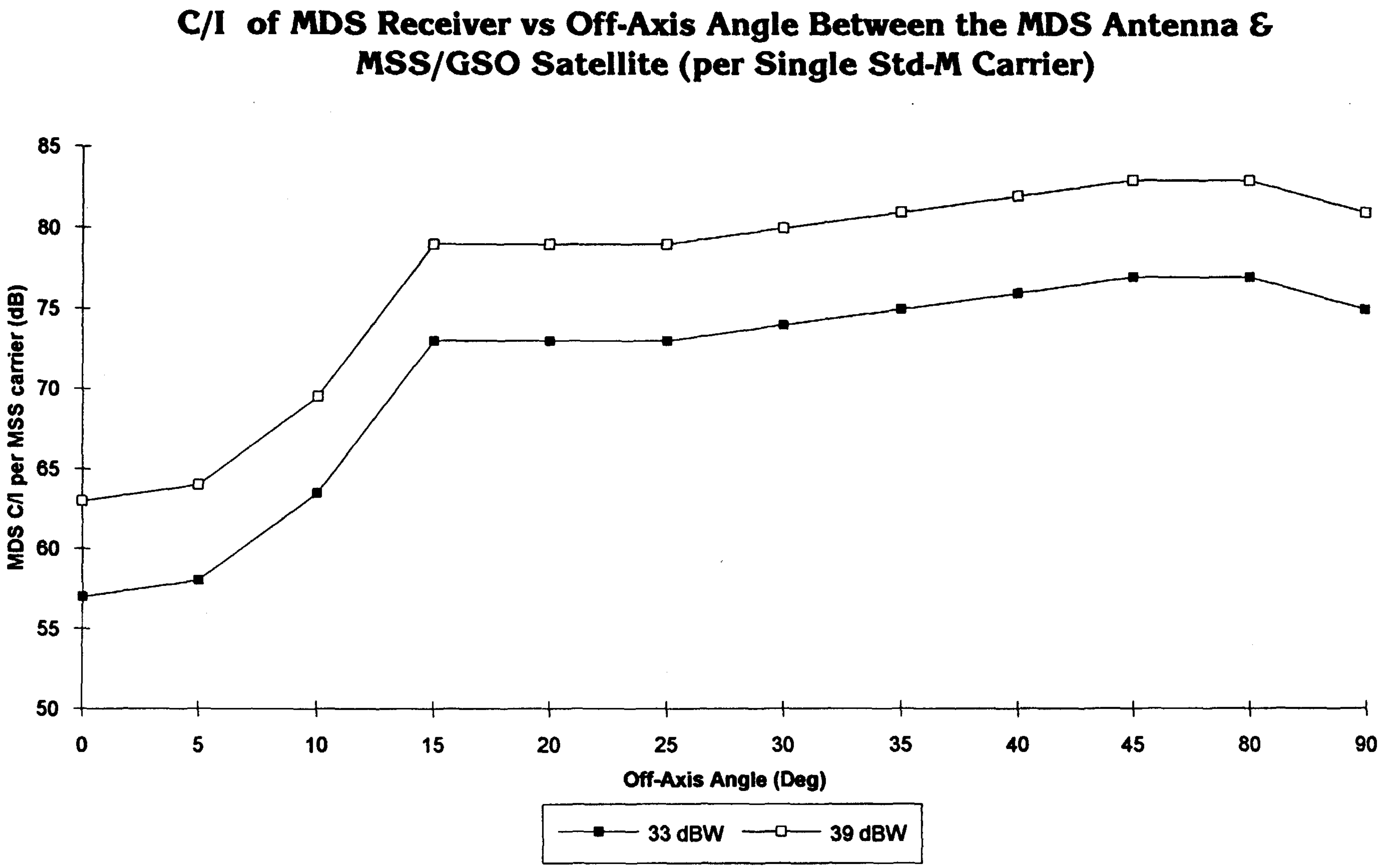
2.1 MSS Downlink Interference Into MDS Receivers

Based on our initial analysis, COMSAT believes that MDS TV links at 2 GHz would experience only minimal interference potential from MSS satellite operating in the same bands due to the fact that there is but a 2 MHz overlap with one of the MDS microwave links operating on channel 2 at 2156-2162 MHz. Even in this overlap area, however, MSS downlinks would impact MDS channel 2 only if INMARSAT or other MSS operators were use to the new Region 2, MSS allocations at 2160-2170 MHz.

The results of an analysis of interference into this one MDS channel were shown in a previous COMSAT filing prior to WARC-92. The issue at that time was in consideration of a COMSAT suggested U.S. proposal for MSS downlink allocations in the 2160-2180 MHz band. As seen in Figure 3, MDS can expect very high values of C/I, better than 55 dB, in the presence of Standard M downlink carriers, with the MDS link power at the 33 or 39 dBW maximum carrier power levels permitted, as set forth in the Part 21 of the Commission's Rules.[6] Not shown here, but in the previously

[6] Figure 3 shows C/I values that were calculated at the MDS receiver input, due to each LMSS satellite downlink carrier (Standard M EIRP/carrier)--as a function of off-axis angle between the MDS terrestrial receive antenna main-beam axis and the MSS satellite. Since the MDS antenna are essentially pointed towards the horizon, the off-axis angle can also be viewed as the elevation angle of the satellite, WRT the local horizon. Curves of C/I were generated from two MDS EIRP levels: 33 and 39 dBW. These two desired carrier levels were chosen since the recent revision to Part 21, Subpart K of the Commission's Rules, allows maximum EIRPs of up to 33 dBW for omnidirectional MDS transmit

Figure 3



C/I=(Terr EIRP-Terr PL-Fad/Shad Loss+Terr Rx Ant G)-(Sat EIRP-PL+Terr Rx Ant G(Angle)-Xpol)

MSS2MDS.XLC

cited filing by COMSAT, the required C/I for "just perceptible interference to a median NTSC receiver...." varies from 30 to 55 dB. As such, interference from MSS downlinks into MDS receivers should be well within acceptable levels (FCC defines "harmful" interference for MDS as C/I's less than 45 dB).

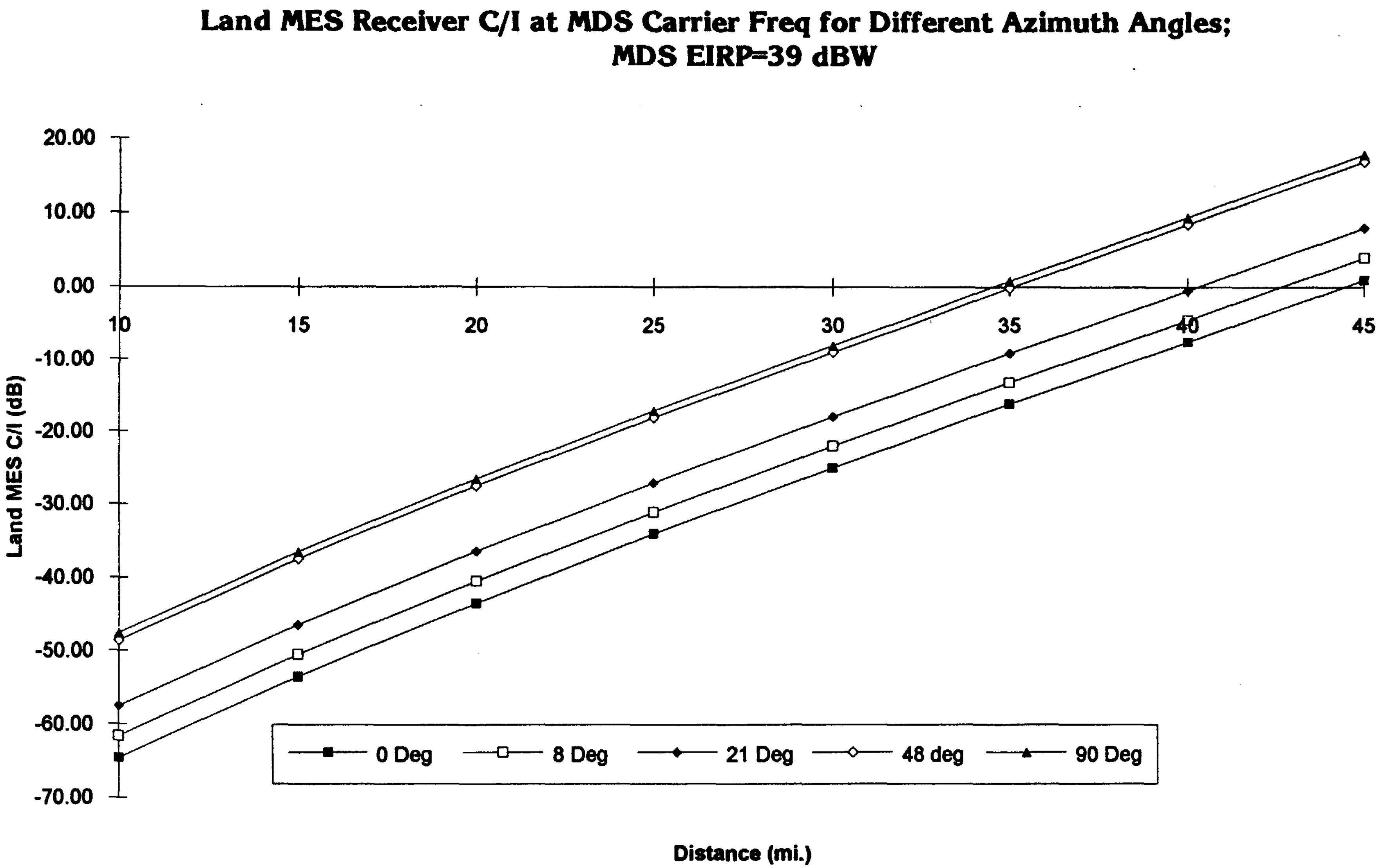
2.2 MDS Transmitter Interference into Mobile Earth Station Receivers

COMSAT also has examined the likelihood of MDS interference into MES receivers.[7] Our analysis focused on the 2 MHz overlap in the 2160-2162 MHz band of MDS channel 2 and effect this MDS interference would have on LMSS mobile terminals receiving satellite downlinks in same geographic areas. The key point is the spectra of DSB-AM transmission used by MDS. Since the narrowband LMSS receivers will intercept only a small fraction of the total MDS carrier power, the power in the vestigial sideband (VSB)-AM signal (note not FM as in the case of the ENG TV links). Laboratory simulation was used to estimate the spectra from the MDS picture carrier. It was found that for VSB-AM signal approximately 80% of the total transmit power is in the picture carrier and 20% in the remaining sideband. The interference from the MDS transmitter into the LMSS mobile terminal receiver will depend upon the distance and the azimuthal angle between MDS

antennas and 39 dBW for directional antennas.

[7] See COMSAT Comments to the FCC Supplementary Notice of Inquiry, Gen Docket No. 89-554, dated April 12, 1991 Pages 4-7.

Figure 4A



C/I=(Sat EIRP-PL+MES Rx Ant G)-(TV Carrier EIRP-Terr PL-Fad/Shad Loss+MES Rx Ant G(Az)-Xpol)

MDS2MSS3.XLC